AGRICULTURAL RESEARCH SERVICE

MANAGEMENT REVIEW

Issue Number 1 December, 1977

The idea of an ARS management-oriented publication grew out of discussions with groups of newly-appointed managers. In our remarks during orientation-training sessions, we've tried to make a point of their need to widen the horizons of their keeping "up with the literature" to include management-oriented articles. When pressed for suggestions as to specifics, we had to admit that many of the articles in the traditional management, administration, and personnel journals were not appropriate for an agricultural research organization like ours. However, there are occasional articles and books from these sources that are appropriate--either specifically or with such general and universal applicability that we can profit from them.

One of the purposes of this publication is to bring these materials to your attention--listing by title, by abstracts or reviews, or by providing copies of the entire article where appropriate.

There are a number of other uses for this new publication--communication of management-related concerns and activities in the Agency, providing notices about upcoming management and policy analysis seminars and symposia, reviewing those that have already taken place, and providing a forum for those of you who may wish to share some ideas, concerns, or experiences.

Let us have your suggestions and reactions.

--R. J. McCracken

The ARS Management Review is for your use--you are invited to participate in its content and directions.

If you think of a subject that would make a good article for the Review, or if you would like to write a piece based on your experiences in research management, call or drop a line to Bob Nelson, Information Division.

If you read an article that you believe might be appropriate for reprint or abstracting, send a copy with your impressions to Chet Cotton, Personnel Division.

If you attend a meeting, training session, or course that you think is especially valuable, send a brief evaluation to Dick Fraser, Personnel Division.

Letters to the Editor that are of general interest to the readership may, from time to time, be reprinted with the author's permission.

-- Bob Nelson

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The ARS Management Review is a joint effort of the Information and Personnel Divisions of the Agricultural Research Service, U.S. Department of Agriculture. It is distributed to ARS executives and a limited number of other interested individuals. Articles appearing in the ARS Management Review reflect the opinions of the authors, and do not necessarily reflect the positions of the Agricultural Research Service or the U.S. Department of Agriculture.

Scheduled Meetings of Interest

American Society for Public Administration Annual Meeting in Phoenix, Arizona, April 9-12, 1978. ASPA has a strong "Section on Science and Technology in Government."

Society of Research Administrators joint Southern and Midwest Sections Regional Meeting in Nashville, Tennessee, April 13-14, 1978.

Society of Research Administrators Western Section Regional Meeting in Seattle, Washington, May 21-24, 1978.

Academy of Management 38th Annual Meeting in San Francisco, California, August 9-13, 1978. The Academy has an active "R&D/Technology/Innovation Management Interest Group."

Conference for the Advancement of Research 32nd Annual Meeting in Biloxi, Mississippi, September 24-27, 1978.

Society of Research Administrators 12th Annual Meeting in Boston, Massachusetts, November 5-8, 1978.

Schedule of Meetings - T. W. Edminster

December

1-13	Hungary, London, Moscow
	Hungary: Review of international agreements in agriculture.
	London: Briefing before going to Moscow--the Research and Technology Work Group, US - USSR Joint Committee.
	Moscow: Meet with the USSR Research and Technology Work Group.
14-15	American Society of Agricultural Engineers meeting in Chicago, Illinois (speech).

February

12-17	American Association for the Advancement of Science meeting in Washington, D.C.

ARS REORGANIZATION

Secretary of Agriculture Bob Bergland has announced a package of reorganization initiatives to realign units of the Department according to major function. The reorganizations will provide opportunities for better management by focusing responsibility for similar functions in a smaller number of agencies and administrators, and by reducing the number of administrative officials reporting to the Secretary, the Assistant Secretaries and Directors.

This reorganization will reduce the number of agencies and offices in the Department of Agriculture by 14. The agencies and offices affected operate some 114 programs with 23,527 employees and a combined Fiscal Year 1978 budget of $2.5 billion.

The portion of the reorganization of most interest to ARS managers is that which will establish a new Science and Education Administration (SEA), headed by a Level V Director of Science and Education. The Science and Education Administration is designed to carry out the Congressional mandate under Title XIV of the Food and Agriculture Act of 1977 to "increase cooperation and coordination in the performance of agricultural research by Federal departments and agencies, the States, State agricultural experiment stations, colleges and universities, and user groups.

SEA will assume the primary responsibility for food and agricultural research and extension coordination under Title XIV of the Food and Agriculture Act of 1977. A planning staff will report to the Director of Science and Education. This unit will also provide staff support for the Joint Council on Food and Agricultural Sciences and the National Agricultural Research and Extension Users Advisory Board, which are authorized by Title XIV of the 1977 Act. In addition, SEA will provide administrative support services to all subunits.

The Assistant Secretary for Conservation, Research and Education will continue to oversee all research and extension activities brought under SEA. The ability of the Assistant Secretary to coordinate research and extension activities within the Department of Agriculture and to fulfill the responsibilities of the USDA as the lead agency for food and agricultural sciences should be enhanced by this reorganization. The Assistant Secretary will now be able to provide policy direction to a single person responsible for research and extension within USDA, the Director of Science and Education.

The new Science and Education Administration will encompass 36 programs, having a combined FY 78 budget of $740,830,000, and 8,894 permanent full-time employees as of June 30, 1977.

Legislative Developments

The Congress has recently passed and the President has signed S. 275, the Food and Agriculture Act of 1977 (PL 95-113), which has been called by many the most comprehensive farm legislation ever. Of particular importance to ARS is Title XIV, the "National Agricultural Research, Extension, and Teaching Policy Act of 1977." This title includes an increase in the annual authorization of appropriations for agricultural research from $505 million in FY 1978 to a total of $780 million in FY 1982 and would require reauthorization of all such programs at the end of five years. It would further provide for a competitive research grants program authorizing $25 million in FY 78 increasing annually to $50 million in FY 1982. Other programs authorized were: grants to rapidly expand scientific breakthroughs; grants for expanded research facilities and for constructing or expanding veterinary medical schools; small farm research and extension; permanent authorizations for research and extension at the 1890 land grant colleges; solar energy research and development; research on extraction of hydrocarbons and alcohols from agricultural commodities; expanded extension programs over the next five years; and grants for animal health and disease research.

Solar energy for agricultural uses was given high priority with increased funding and provisions for demonstration projects under the bill. The measure also provides for educational grants and fellowships, an annual national agricultural research award, and creation of two statutory advisory groups: (1) a Joint Council on Food and Agricultural Sciences; and (2) a National Agricultural Research and Extension Users Advisory Board. Lastly, the bill establishes USDA as the lead agency in the Federal Government for research, extension and teaching in the Food and Agricultural sciences. A major objective of the bill is to improve coordination, planning and dissemination of information on agricultural research. It should be noted again that this is only authorizing legislation and actual appropriations levels will be determined through the normal budgetary processes.

Other legislation that may prove to have considerable impact on ARS programs are PL 95-95, "Clean Air Act Amendments of 1977" and PL 95-87, "Surface Mining Control and Reclamation Act of 1977." Public Law 95-95 specifically directs the Secretary of Agriculture to "encourage and support research programs that will increase scientific knowledge of the effects of changes in the ozone in the stratosphere upon animals, crops, and other plant life" and to report to EPA and the Congress by January 1, 1978, and biennially thereafter the results of these studies and recommendations for legislation or regulation. While these pieces of legislation appear to be significant in terms of program impact, they are still in the embryonic stage of development and it remains to be seen what role if any ARS will be expected to perform.

--Don Ladd

ARS MANAGEMENT AND PLANNING SYSTEM

The achievement of the research missions in ARS requires a complex of planning, management, and support functions, as well as highly productive researchers. Over the years, these functions in ARS have evolved into operable systems and procedures that have helped the scientists make many significant contributions to society and to their professions. However, what was adequate for one time and situation have become less than adequate for the needs of another time and under a different set of circumstances--less expansive budgets, requirements for more explicit planning procedures, the need for a more clearcut national focus to research efforts, and others. These require adjustments in research direction and in the planning and management of that research that generally cannot occur on a purely ad hoc basis. There should be little doubt by anyone that we as an agency are in the midst of some rather significant changes in circumstances, the full range of which are substantial in context and far reaching in impact. The development of a more systematized set of planning processes, information and reports handling procedures, and more clearcut management responsibilities and relationships is the Agency's response to these changing conditions.

The Introduction of MAPS

With the publication of the ARS-MAPS document earlier this year and the concurrent development of the ARS National Research Programs, the Agency formally launched its effort to develop a comprehensive management and planning system. The development of ARS-MAPS was concerned foremost with the specification of a Program Structure and the informational requirements and procedures to make it operational. ARS-MAPS describes concepts and guidelines necessary for program enunciation and use, and on a more general level, describes affiliated components and procedures to be included in a management and planning system for the Agency. It also specifies areas of responsibilities, focusing primarily on the national aspects of program development.

This product has proven very useful to the Agency by providing the basic structure that everyone in the Agency can use and/or relate to in planning and managing national programs of research, can use in coordinating planning activities with other research agencies, and in communicating research needs with our primary clientele. The structure already has proven more useful than most in the Agency have realized. In fact, we are only just beginning to realize how useful it eventually will be.

The Current Status of MAPS

For much of the Agency's personnel, the ARS-MAPS document and the associated NRP's have become known as "MAPS." But, MAPS must include much more than these. If the intent of any good management and planning system, including MAPS, is to foster the most effective research of which the Agency is capable, that system must include <u>all</u> the procedures and systems concerned with the implementation, execution, reporting, review and support of

research activities. An effective program structure is a necessary component but it is not sufficient to guarantee effective research programs by itself. Budget Development Systems, Personnel Systems, Facilities and Equipment Systems, Management Systems, and all other systems that service our research plant must operate effectively and in concert with one another if we are to assure the Secretary, the President, the Congress, and others to whom we are responsible that ARS is adequately satisfying its basic research missions. This degree of effectiveness and integration of operation, efficiently organized and performed is what MAPS is and is all about.

Where are we now? Certainly, we have a history of accomplishment in this Agency, which reflects that we must have been doing something right with respect to planning and managing our research over the years. Also, much has been accomplished by way of improving planning and management functions, especially since reorganization. We do have systems that work quite well, some that operate relatively well but still need improvement, and some that still have much to be done with them. Each of our program, administrative management and line management staffs has developed systems that would be considered by their peers to be quite effective. These have been developed largely on their own initiative but largely without much interactions with other staff groups. Generally, this has been entirely appropriate because at the time most of these systems would be considered at a relatively adolescent stage of development and probably could not have effectively profited from other staff involvement in their efforts. Nevertheless, the Agency significantly benefited from these efforts.

The Evolution of MAPS

Now we are at a significant crossroads in our efforts to improve these systems. While all of our management and planning systems need further improvement, it is unlikely that further advances can be made by each staff with the same degree of independence that has characterized efforts in the past. We have already noted cases where changes made to improve performance of functional responsibilities in one staff area has impeded somewhat the effectiveness of functional responsibilities in other areas. An example is the basic conflict between accounting and program classifications on how research should be organized at locations. This suggests that further development in staff functions will require more integration of improvement activities than has occurred in the past. This integration is essentially the purpose of the MAPS development effort.

How do we expect to achieve this? We do expect that the individual Agency staffs will continue to improve and fine-tune their procedures. The initiation of new efforts are being encouraged and others being fostered. MAPS will come into play in these efforts by helping to integrate individual staff efforts to improve systems with other comparable efforts by other staffs, by indicating where linkages occur, monitoring for possible conflicts and making each staff aware of possible impacts on other systems and on the overall effectiveness of the Agency's management and planning systems.

It is important to emphasize that "integration" in the sense used above means neither organizational integration nor integration of control. The basic philosophy of MAPS, as it is with the Agency as a whole, is to foster the greatest degree of decentralization in decisionmaking that is consistent with the effective operation of the Agency as a whole. Hence, the ideal situation would be that every functional staff group would make the proper decisions on their own regarding form and procedures, with no or minimal direction from above or without that staff group. This is a desirable goal for MAPS to pursue--to develop sets of overall guidelines on structures and procedures by which each functional staff group can judge on its own whether or not it is functioning as it should and judge on its own the form and procedures required to carry out its responsibilities in a manner that contributes to the Agency's operations most effectively. In a real sense, MAPS becomes an "umbrella system" under which and against which change can "evolve" rather occur in periodic quantum jumps.

The degree to which MAPS can be developed to this state of development will require a degree of participation on the part of groups and individuals in the Agency than almost anything we have ever done before. Efforts to further develop MAPS will require the time of many very busy people in the Agency. It will require a willingness on the part of everyone to voluntarily and on their own come forth with the perception of problems, strengths and recommendations for improvement in structures, organization, and procedures. It will require administration and management at all levels to visibly and vocally support the concept at every opportunity. And not the least, it will require on the part of all ARS employees a willingness to accept it as a workable means of guiding our individual and group efforts. With such an integrated system we may, together, stand a better chance of meeting the immense challenges that lie ahead for ARS as the leader of the agricultural and food research community.

-- Walt Fishel

Reviews of Courses and Meetings

Event: "Situational Leadership and Motivational Effectiveness" presented by Paul Hersey under the auspices of AMR.

Attendees: G. E. VandenBerg and J. W. Smith

Evaluation: "In our opinion, widespread understanding and application of situational leadership principles will contribute to major advances in the quality of leadership throughout the Agency." "While not a panacea, we believe the principles of situational leadership have great potential."

Event: "Program Analysis and Evaluation Workshop" presented by John E. Keller under the auspices of the U.S. Civil Service Commission.

Attendees: E. Fred Schultz, Jr., and Milton T. Ouye

Evaluation: "Mr. Keller is an excellent teacher." "...Send representatives to the next session to be given August 8-12." "...Explore the possibility of Mr. Keller designing a course specifically for ARS on program analysis and evaluation."

Did you know that an index of formal training courses suitable for ARS' present and future executives is now available? A preliminary listing was issued by Training and Career Development Branch, on September 15, in conjunction with the ARS Future Executive Program. All courses listed come highly recommended by ARS personnel who have attended. Their telephone numbers are listed so you can contact one or more of them before deciding to attend a particular course. For a copy of the list or to recommend a course you have attended, call R. F. Fraser (FTS 436-8123) in Hyattsville.

"I enjoyed reading the article...from Electronics Design. (We might consider) following Texas Instruments' example by early funding when an idea has merit, lest we shut off the motivation to contribute new ideas."

-- Steven C. King

"Several points of interest in the article by Fred Bucy. They relate to ARS 'Ideas,' (and the) use of discretionary funds as a source of 'strategic' funding."

-- Ernest L. Corley

Fred Bucy of TI Speaks on Managing Innovation

Like motherhood and apple pie, innovation is something everybody favors. What most people don't know is that you can actually plan and organize for it.

But no system ever created an innovation. People make innovations. So you have to create an environment in which people will be stimulated to innovate. And that environment must pervade your company because innovators are where you find them. Your R&D organization is not the sole source.

The system we use at TI is one we call OST—for Objectives, Strategies and Tactics. It's designed to help us nurture and manage innovation.

It starts with the idea that innovation or invention is a very tender thing. You have to bring it up very carefully. It can starve if it isn't quickly nourished And innovations perish without champions.

So we make initial resources available quickly and easily. Being able to allocate resources properly is the real key to the system. When a fellow comes up with a new idea, a new product, or a new solution to something, we can get the resources to him. Nothing is more discouraging than having a good idea and not being able to get the funding for it. The best way to motivate innovators is to provide resources to help them carry out their ideas.

This is far more important than it appears. You must have a source of "strategic" funding—money that's discretionary to your current operations. Such funds must be kept separate from day-to-day business requirements.

If you leave this allocation to individual managers, you force them into conflicts between today's profitability and tomorrow's growth. For the same reason, you must segregate the reporting of strategic and operating expenses so that you don't unwittingly penalize managers who carry out strategic programs. Unlike operating expense, strategic expense is desirable in business.

Further, you have to be wary of the old problem that resources do tend to gravitate away from embryonic ideas toward well developed products.

We have two basic ways to provide funds for innovations--the IDEA program and the Wild Hare program.

Under the IDEA program, we distribute modest sums of money to a large number of IDEA program representatives throughout the company.

When an engineer says, "I have an idea for doing such-and-such, and I think I can prove its feasibility in six months," he merely has to convince the IDEA man, who has authority to provide funding right away, without further approval.

The engineer will have a timetable in which to prove that he's making progress. At some point he may need an extension. And at some point he may develop his idea to the point where it enters into competition with other ideas for further funding.

In many cases the engineer who develops the original idea may continue in his own job while he's developing the idea. He may tell his boss that he has the funding to carry out a new idea and he needs some time to work on it. They'll work out a way to give him the time to work on the idea.

I know that many management texts take it as gospel that if you give a man responsibility, you must give him authority to go with it. Of course, that's frequently true. You can't give a man responsibility for running a production line or a lab without giving him authority over that line or lab.

But we believe deeply that if a man sees an opportunity to be pursued outside his immediate area, he has the responsibility to do something about it. Maybe he should bring it to the attention of his peers, his boss, or a committee. He should not sit back and say, "That's not my job; I'm not responsible." The same rule applies in corporate or civic ethics. If you see something wrong, you are obligated to do something about it, even if it's not in your area, and even if you don't have the authority.

So, if a man is given responsibility for developing a new idea, he may have to call on resources in other departments--where he has no authority. He may be asking for the services of people who "outrank" him . . . but I should add that rank doesn't play much of a role at TI.

We may have a situation where, so to speak, a sergeant needs services from a captain. Well, with our OST system we give him the funds to buy those

services. He can say, "I need this and I have the money to pay for it." And that happens frequently.

Sometimes a man's idea is such that he can't pursue it while he's working at his regular job. He may need full time to develop the idea. In this case he obviously must be relieved of his regular duties. And this raises another question.

The normal boss wants to keep his productive people because they make him look good. He's reluctant to lose an innovative man—even for a relatively short time. He needs an inducement to support the innovator even if he'll move to a new effort.

Most of the time this isn't a problem because the innovator is in his own group and it's most likely that the idea will be in his own area of interest. So there's real incentive. He has a great deal to gain from supporting the fresh idea, as it might help him gain additional resources to make his business a success.

But if the engineer comes up with an idea that's not related to the boss's current business, the engineer may be transferred, perhaps temporarily, to, say, the Corporate Engineering Center. In the Corporate Development organization, he may work on products related to any of TI's businesses or to new businesses. If his idea proves successful, he may move with it as it goes into further development and into production. In such a case, the original boss should get the satisfaction of knowing that one of his people played an important role in helping the company grow.

One example is our development of charge-coupled devices. We did not invent them, but we did recognize their potential and funded them with an expectation of a payoff in several years—not immediately.

It's very difficult to set checkpoints when you're trying to get innovation. You can't command invention. So we can't have rigorous milestone reviews in our Wild Hare program. We have to give people the latitude to pursue something over an extended period.

In our Wild Hare program we may be making large investments, but they'll be spread over a long period of time. Since these are important programs, possibly with long-range impact, we don't fund them as quickly as we do the IDEA programs.

Now, as you can imagine, when thousands of people in a corporation are encouraged to innovate, we must often face the problem of deciding what business we're really in, especially when we examine some of the Wild Hare proposals. And that's precisely one of the functions of the OST system.

It turns out that we usually don't have to worry about that problem since most of the fellows working here are not likely to come up with an invention in, say, biology. But every once in a while somebody comes up with an idea that makes us evaluate the merits of entering a new business.

A new business can sometimes be an outstanding payoff of the OST system which, remember, is first and foremost a philosophy. It's a philosophy that keeps pointing to the fact that we are in the business of innovation. The philosophy is a foundation on which we build a structure to nurture innovation.

We always stress the probability of success. IDEA projects may have one chance in, say, 20 or 25. Wild Hare projects may have even lower probabilities for success. If a program has a 50-50 chance, it will probably be supported by general OST strategic funds.

As you can imagine, the system isn't flawless. One of the problems we run into is the fact that bright innovators tend to be promoted to the ranks of management, and then get buried in administrative details. Of course we reward innovators with money and prestige. But there seems to be greater social prestige for the manager.

It's often difficult to get the innovator to realize that his biggest contribution is to remain the creative genius, rather than to get into the management progression. That idea can be frustrating to the genius because he thinks he has to carry everything all the way through.

The fellow who can generate a new idea, convert it to a product, push it through production and get it into the field—that fellow is pretty scarce. But nobody likes to give his baby away. So you have to protect the creative guy by rewarding him sufficiently so that he remains motivated to stay in his position.

The genius who comes up with the basic concept is probably not the individual who can get a product through a production line. Sometimes we let an innovator find out for himself. Then we can get him to return to what he really loves and does best.

Of course, you have to make sure that the innovator's salary, bonuses and recognition will be an adequate reward. In fact, we have what we call the TI Fellow Awards for the truly outstanding innovators. We present these at our Strategic Planning Conferences and publish them throughout the company. So our innovators do get recognition from their peers. The innovator can become a Fellow instead of a vice-president. And this is one way we cope with the fact that his neighbors don't know if he has made important innovative contributions to the corporation, but they sure know if he's a vice-president. It doesn't seem to be enough that he may make as much money as a vice-president. There's great social value in the fact that a business card says he's a vice-president.

Unfortunately, vice-presidents tend to become buried in administrative work. The OST system is dedicated in large measure to making the manager spend a lot of time thinking about the nature of our business and how to improve it instead of spending all his time on current administrative duties. We try to get all our managers to spend a significant part

of their time thinking about innovation and strategic planning because that's what we're all about.

We have a "two-hat" system for our managers. A manager must be a short-term operating manager and he must develop long-term strategic skills. He should develop the self-discipline needed to divide his time wisely between today's demands and tomorrow's needs. He must not let himself be consumed by today's business requirements.

Without new products, we cease to grow. Without innovation in management, our overhead continues to grow. So we always worry about how to become more productive in everything we do.

You have to realize that the OST philosophy doesn't apply only to engineering. It might involve a new product, a new process, a new marketing technique, even—and especially—a new management technique. Productivity is the key.

Here's the best example: Between 1970 and 1976 we doubled our billings with an increase of only 16% in people. We didn't do that just by making everybody work hard. It was done by people thinking about their jobs and being innovative in what they're doing. Being more productive is getting more out with less effort. And that's part of the OST system.

We have a very simple measure of this productivity. It's called the People Effectiveness Index, which is simply our billings divided by total payroll. We try to make that improve every year.

Of course, no system is perfect. It's easy to fall into the trap of thinking that a system exists independent of people. And it's easy to let the system cover too much. That can lead to a heavy paperwork burden. Or the system can become too mechanistic, giving people the feeling that the system controls events. You must continue to refine and improve any system.

OST really started in the early days of our company. When we had a sales volume of substantially less than $200 million, it was possible for the president and the vice-presidents to get together and operate the OST system among themselves. They could follow what was important and get things started.

One of the early Wild Hares—long before we invented that name—was the silicon transistor. When we introduced that in 1954 we were enjoying a volume of somewhat over $24 million.

Pat Haggerty, who was then chairman of the board, sold the board on the idea of developing the silicon transistor. We could do things very informally at that time because lines of communication were short.

But Mr. Haggerty and others like him recognized the fact that, as we got bigger, we would need a system to help us see where the new opportunities were and to allocate the proper resources to help us take advantage of them.

He wanted to institutionalize what was already being done informally. "How are we going to handle this," he asked, "when we get to be a half-billion-dollar corporation, or a billion dollar corporation?"

We started formalizing the system in the early 1960s and we've been developing it ever since. Though it's now in an advanced state, we still come up with improvements.

If we didn't do that, the system would stagnate and die. What worked well with one size corporation may not work well at another level. To be useful, OST must be a living thing, a way of life, a philosophy that's ingrained in all your people. You can't just say, "Today is OST day."

OST is not merely a way to fund new ideas—though that's an important role. It can be, and often is, a meeting on a production line, where a group of people get together and talk about how to improve an operation. We do get inputs right from the people working directly on the line.

One of the best examples of ideas from the production floor I heard recently during a visit to Italy, when a girl from the production floor came out with a better layout of the product line she worked on.

Our effectiveness depends very much on our innovative skill. We want to use every technique to improve that skill. That's our life blood.

Who is Fred Bucy?

He went to school in Texas, earning his BS in Physics in 1951 at Texas Tech University in Lubbock and his MS Physics, two years later when he was 25, at the University of Texas in Austin.

Then, of course, he came to work in the Central Research Lab of Texas Instruments, starting in geophysical instrumentation. He left the lab to carry one of his ideas through production at TI's plant in Houston. His responsibilities increased and in 1961 he was made general manager of the Houston operation. In 1963 he was made vice-president and put in charge of TI's military business. He continued his rise and, in 1967, he was given charge of the company's semiconductor activities; in 1972 he was made executive vice-president; then chief operating officer in 1974 and president in 1976.

"The Zero-Base Approach to Government Budgeting" is a somewhat detailed discussion of zero-base budgeting from the "leader" of the movement, Peter A. Pyhrr. While his examples may not readily translate into the R&D arena, the article can help you to understand the movement and the kinds of budgetary decisions being required at the agency and departmental levels. A wag suggested that, if you understand the article completely on first reading, you might consider that a "Pyhrr-ic victory."

-- Chet Cotton

The Zero-Base Approach To Government Budgeting

Peter A. Pyhrr

Zero-base budgeting is an emerging process, which has been adopted by a variety of industrial organizations in many sectors of the economy, as well as state and local governments.

As it is generally practiced today, zero-base budgeting was developed at Texas Instruments Inc. during 1969. The process was first adopted in government by Governor Jimmy Carter of Georgia for the preparation of the fiscal 1973 budget, and the process is still being used today in Georgia. It would appear at this point that zero-base budgeting will be adopted in the federal government, sponsored by both the President and Congress. The Government Economy and Spending Reform Act of 1976 (S. 2925) was introduced by Senator Muskie, and co-sponsored by more than 50 per cent of the Senate when it was reported out of the Government Operations Committee. The bill required a congressional zero-base review and evaluation of every government authorization for programs and activities every five years, and requires the Director of OMB to develop a program for zero-base budgeting for all departments and agencies of the Executive Branch.

There are three key users of the zero-base analysis in government:

1. Legislative (Congress, state legislature, city council)
2. Executive (President/OMB, governors, mayor/city manager)
3. Agency (agency director, program and department managers).

The focus of each user is obviously different, with the legislature requiring more summarization and focusing on public priorities and objectives, the agencies requiring more detailed information and focusing on program implementation and efficiency, and the executive straddling the needs of legislature and agency. However, regardless of specific information needs and focus, the legislature, executive, and agencies must all address themselves to two basic questions:

1. Are the current activities efficient and effective?
2. Should current activities be eliminated or reduced to fund higher-priority new programs or to reduce the current budget?

These two questions are the focus of the zero-base budgeting process.

Peter A. Pyhrr is president, Pyhrr Associates, Inc. Earlier he developed zero-base budgeting at Texas Instruments and Alpha Wire Corporation. He has been involved in installing zero-base budgeting both in industry and in government. He is author of *Zero-Base Budgeting.*

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The Zero-Base Approach

On December 2, 1969, at the Plaza Hotel in New York City, Arthur F. Burns, then counselor to the President of the United States, addressed the annual dinner meeting of the Tax Foundation on the "Control of Government Expenditures." In this speech, Dr. Burns identified the basic need for zero-base budgeting; but he also expressed his concern that such a process would be difficult if not impossible to implement:

> Customarily, the officials in charge of an established program have to justify only the increase which they seek above last year's appropriation. In other words, what they are already spending is usually accepted as necessary without examination. Substantial savings could undoubtedly be realized if [it were required that] every agency . . . make a case for its entire appropriation request each year, just as if its program or programs were entirely new. Such budgeting procedure may be difficult to achieve, partly because it will add heavily to the burdens of budget-making, and partly also because it will be resisted by those who fear that their pet programs would be jeopardized by a system that subjects every . . . activity to annual scrutiny of its costs and results.

Dr. Burns was advocating that government agencies re-evaluate all programs and present their requests for appropriation in such a fashion that all funds can be allocated on the basis of cost/benefit or some similar kind of evaluative analysis.

The fears of Dr. Burns that a zero-base approach "will add heavily to the burdens of budget-making" are unwarranted, as I view the matter. None of the organizations that I am familiar with that have implemented the approach have added additional time onto their calendar for the preparation of a zero-base budget (other than design and training prior to the budget preparation process which is a normal start-up requirement of any new process). To be sure, zero-base budgeting usually involves more managers and takes more management time than the traditional budget procedures. However, it must be taken into account that the zero-base approach includes objective setting, program evaluation, and operational decision making, as well as budget making, whereas traditional budgeting procedures often separate these management aspects. In the worst case, the traditional budget process is merely a way to obtain an appropriation with the operational decision making and operating budgets determined after the total appropriation has been obtained. If we added the total time of these additional management elements to the time used by the traditional budgeting process, then the time requirements of zero-base budgeting do not add to management's burdens. In fact, after the initial year's implementation, the zero-base approach can actually reduce management's burden as the zero-base thought process and methodology become ingrained into management's normal way of problem solving and decision making.

Zero-Base Budgeting Procedures

The zero-base approach requires each organization to evaluate and review all programs and activities (current as well as new) systematically; to review activities on a basis of output or performance as well as cost; to emphasize managerial decision making first, number-oriented budgets second; and to increase analysis. However, I should stress that zero-base is an approach, not a fixed procedure or set of forms to be applied uniformly from one organization to the next. The mechanics and management approach has differed significantly among the organizations that have adopted zero-base, and the process must be adapted to fit the specific needs of each user. In governmental jurisdictions, for example, certain expenditures may be fixed by law.

Although the specifics differ among organizations, there are four basic steps to the zero-base approach that must be addressed by each organization:

- Identify "decision units."
- Analyze each decision unit in a "decision package."
- Evaluate and rank all decision packages to develop the appropriations request.
- Prepare the detailed operating budgets reflecting those decision packages approved in the budget appropriation.

Defining Decision Units

Zero-base budgeting attempts to focus management's attention on evaluating activities and making decisions. Therefore, the "meaningful elements" of each organization must be defined so that they can be isolated for analysis and decision making. For the sake of terminology, we have termed these meaningful elements "decision units." The definition of decision units in most organizations is straightforward, and the decision units may correspond to those budget units defined by traditional budget procedures.

For those organizations with a detailed budget

unit or cost center structure, the decision unit may correspond to that budget unit. In some cases, the budget unit manager may wish to identify separately different functions or operations within his budget unit if they are significant in size and require separate analysis. He may therefore identify several "decision units" for a budget unit. If an organization has a well-developed program structure, the decision unit may correspond to that lowest level of the program structure (program element, activity, function). Decision units may be defined at the sub-program level if there are separate organizational units within that program element. The resulting decision packages at the sub-program element level can then be grouped to evaluate the program element. In the same manner, decision packages for each program element (or sub-program element) can be grouped to evaluate each program.

The decision packages built around each decision unit are the building blocks of the budget and program analysis. These building blocks can be readily sorted either organizationally or programatically. For those organizations without a detailed program structure, the information and analysis developed by zero-base provides a readily usable data base from which a program structure can be developed.

Decision units can also be defined as major capital projects, special work assignments, or major projects. Each organization must determine for itself "what is meaningful." In practice, top management usually defines the organization or program level at which decision units must be defined, leaving it to the discretion of each manager to identify additional decision units if appropriate.

The Decision Package Concept

The "decision package" is the building block of the zero-base concept. It is a document that identifies and describes each decision unit in such a manner that management can (a) evaluate it and rank it against other decision units competing for funding and (b) decide whether to approve it or disapprove it.

The content and format of the decision package must provide management with the information it needs to evaluate each decision unit. This information might include:

- Purpose/objective
- Description of actions (What are we going to do, and how are we going to do it?)
- Costs and benefits
- Workload and performance measures
- Alternative means of accomplishing objectives
- Various levels of effort (What benefits do we get for various levels of funding?)

The key to developing decision packages is the formulation of meaningful alternatives. The steps that should be used in developing decision packages include:

1. Alternative methods of accomplishing the objective or performing the operation: Managers should identify and evaluate all meaningful alternatives and choose the alternative they consider best. If an alternative to the current method of doing business is chosen, the recommended way should be shown in the decision package with the current way shown as the alternative not recommended.
2. Different levels of effort of performing the operation: Once the best method of accomplishing the operation has been chosen from among the various alternative methods evaluated, a manager must identify alternative levels of effort and funding to perform that operation. Managers must establish a minimum level of effort, which must be below the current level of operation, and then identify additional levels or increments as separate decision packages. These incremental levels above the minimum might bring the operation up to its current level and to several multiples of the current level of effort.

The identification and evaluation of different levels of effort is probably the most difficult aspect of the zero-base analysis, yet it is one of the key elements of the process. If only one level of effort were analyzed (probably reflecting the funding level desired by each manager), top management would be forced to make a yes or no decision on the funding request, thus funding at the requested level, eliminating the program, making arbitrary reductions, or recycling the budget process if requests exceeded funding availability.

A decision package is defined as one incremental level in a decision unit. There may be several decision packages for each decision unit. It is these incremental levels that get ranked. By identifying a minimum level of effort, plus additional increments as separate decision packages, each manager thus presents several alternatives for top management decision making:

Elimination:

Eliminate the operation if no decision packages

are approved.

Reduced Level:

Reduce the level of funding if only the minimum level decision package is approved.

Current Level:

Maintain the same level of effort if the minimum level, plus the one or two incremental levels (bringing the operation from the minimum level to the current level of effort) are approved.

Note: The current level of effort refers only to the level of output or performance sometimes referred to as a "maintenance level." However, even at the current level of effort, managers may have changed their method of operation and made operating improvements, so that the current level of effort may be accomplished at a reduced cost.)

Increased Levels:

Increased levels of funding and performance if one or more increments above the current level is approved.

The minimum level of effort is the most difficult level to identify, since there is no magic number (i.e., 75 per cent of the current level) that would be meaningful to all operations. The minimum level must be identified by each manager for his/her operations. The minimum level must be below the current level of effort. The minimum level should attempt to identify "that critical level of effort, below which the operation would be discontinued because it loses its viability of effectiveness." There are several considerations which can aid managers in defining the minimum level of effort:

1. The minimum level may not completely achieve the total objective of the operation (even the additional levels of effort recommended may not completely achieve the objective because of realistic budget and/or achievement levels).
2. The minimum level should address itself to the most critical population being served or attack the most serious problem areas.
3. The minimum level may merely reduce the amount of service (or number of services) provided.
4. The minimum level may reflect operating improvements, organizational changes, or improvements in efficiency that result in cost reductions.
5. Combinations of 1 through 4.

By identifying the minimum level, each manager is not necessarily recommending his operation be funded at the minimum level, but is merely identifying that alternative to top management. If a manager identifies several levels of effort, he is recommending that all levels be funded.

Example: Air Quality Laboratory – The following example of the Georgia Air Quality Laboratory (Air Quality Control) illustrates the type of analysis that each manager needs to make in order to prepare decision packages. The Air Quality Laboratory tests air samples collected by field engineers throughout Georgia. It identifies and evaluates pollutants by type and volume, then provides reports and analyses to the field engineers. The manager involved made the typical two-part analysis; first, identifying different ways of performing the function; and second, identifying the different levels of effort.

1. Different ways of performing the same function:
   a) Recommended decision package: Use a centralized laboratory in Atlanta to conduct all tests. Cost – $246,000. This expenditure would allow 75,000 tests and would determine the air quality for 90 per cent of the population (leaving unsampled only rural areas with little or no population problem).
   b) Alternatives not recommended:
      - Contract testing to Georgia Tech. Cost – $450,000. The $6 per test charged by the University exceeds the $246,000 cost for doing the same work in the Air Quality Laboratory, and the quality of the testing is equal.
      - Conduct all testing at regional locations. Cost – $590,000 the first year due to set-up cost and purchase of duplicate equipment, with a $425,000 running rate in subsequent years. Many labs would be staffed at a minimum level, with less than full utilization of people and equipment.
      - Conduct tests in Central Laboratory for special pollutants only, which require special qualifications for people and equipment, and conduct routine tests in regional centers. Cost – $400,000. This higher cost is created because regional centers have less than full workloads for people and equipment.

The recommended way of performing this laboratory function was chosen because the alternatives did not offer any additional advantages and were more expensive. The manager therefore recommended the level of 75,000 tests, at $246,000. Each manager has complete freedom to recommend either *new ways* or the current way

of doing business.

Once the manager had defined the basic alternatives and selected the one he considered best, he completed his analysis by describing different levels of effort for his chosen alternative. For the recommended Central Laboratory in Atlanta, the Air Quality Laboratory manager described and evaluated decision packages that called for different levels of effort for air quality tests. In this case, the manager believed that he could reduce the level of testing to 37,300 samples and still satisfy the minimum requirements of the field engineers who used his services. Therefore, he completed his analysis by identifying the minimum level and additional levels of effort for his recommended way of performing the testing as follows:

2. Different levels of effort of performing the function:
   a) Air Quality Laboratory (1 of 3), cost – $140,000. Minimum package: Test 37,300 samples, determining air quality for only five urban areas with the worse pollution (covering 70 per cent of the population).
   b) Air Quality Laboratory (2 of 3), cost – $61,000 (Levels 1 + 2 = $201,000). Test 17,700 additional samples (totaling 55,000, which is the current level), determining air quality for five additional problem urban areas plus eight counties chosen on the basis of worst pollution (covering 80 per cent of the population).
   c) Air Quality Laboratory (3 of 3), cost – $45,000 (Levels 1 + 2 + 3 = $246,000). Test 20,000 additional samples (totaling 75,000), determining air quality for 90 per cent of the population, and leaving only rural areas with little or no pollution problems unsampled.

The Air Quality Laboratory manager thus prepared three decision packages (levels 1 of 3, 2 of 3, and 3 of 3).

Development of different levels as separate decision packages indicates that the functional manager thinks all levels deserve serious consideration within realistic funding expectations. He identifies three possible levels and leaves it to higher management to make tradeoffs among functions and level of effort within each function.

An Example from City Operations – The decision package analysis can be applied to any federal, state, or local operation or program. The questions raised by the decision package, and the analysis required, are similar even for extremely diverse programs and operations.

To demonstrate this point, I have taken an example of residential refuse collection from the City of Garland, Texas. Garland was the first city to my knowledge to have successfully implemented zero-base budgeting throughout all city departments. The residential refuse example clearly illustrates the zero-base analysis, and identifies the alternatives and funding decisions faced by city managers.

"Residential Refuse Collection" is the city operation responsible for collecting and transporting all residential solid waste for disposal. The manager of this function made the typical two-part analysis: first, identifying alternative means for accomplishing this activity; and second, identifying different levels of effort.

1. Different ways of performing the same function:
   a) Recommended means: City provides the collection service, requiring the use of plastic sacks for all refuse. Plastic sacks are purchased by each resident. Refuse trains are used for heavily populated areas. Front loading refuse trucks are used to empty the refuse trains on the route to transport the refuse to the landfill. Other types of trucks are used for the less-populated areas and country runs. Cost – $790,300.
   b) Alternatives not recommended:
      - Collection without the use of plastic sacks: Additional man required on each crew if garbage cans are used in place of plastic sacks. Added cost of $96,000.
      - Collection of all refuse by the trains. Use of other types of equipment (shu-packs and barrel trucks) are more efficient in less densely populated areas. Purchase of three additional refuse trains and two front loaders would be required, plus eight additional personnel, for an additional cost of $150,000.
      - Contract city refuse collection to a private contractor: Cost $1,108,800 for twice-a-week collection; $900,000 for once-a-week collection.

The recommended means was chosen because the alternatives did not offer any additional advantages and were more expensive.

The residential refuse collection manager completed his zero-base analysis by identifying different levels of effort for performing the function. In

this case, the manager believed he could reduce the level of refuse collection from twice a week to once a week and still satisfy the minimum sanitary requirements. Therefore, he completed his analysis by identifying the minimum level and additional levels of effort for his recommended means of refuse collection as follows:

2. Different levels of effort for performing the function:
   a) Residential Refuse Collection (1 of 3): cost – $607,000 minimum level: Collect residential refuse once per week; brush pick up on Thursday and Friday.
   b) Residential Refuse Collection (2 of 3): cost – $142,800 (Levels 1 + 2 = $750,300). Add one additional collection per week, so that refuse is collected twice per week.
   c) Residential Refuse Collection (3 of 3): cost – $40,500 (Levels 1 + 2 + 3 = $790,300). Collection of brush and white goods an additional two days per week, so that brush is collected every collection day (Mon., Tues., Thurs., and Fri.).

The manager thus prepared three decision packages.

It should be pointed out that there is no magic number of funding levels, but two to five levels are most common. It is also common in many cases to have a great deal of back-up information and analysis, which the decision package itself displays in summary form. In the residential refuse case, there was extensive information and analysis regarding different types of equipment, detailed city maps with an analysis of different route alternatives, and an evaluation of different types of equipment for different routes. The city manager in this case reviewed the detailed analysis, and there were several revisions before the recommendations were put into final form.

The Ranking Process

The ranking process provides management with a technique to allocate its limited resources by making management concentrate on these questions: "How much should we spend?" and "Where should we spend it?" Management constructs its answer to these questions by listing all the decision packages identified in order of decreasing benefit to the organization. It then identifies the benefits to be gained at each level of expenditure and studies the consequences of not approving additional decision packages ranked below that expenditure level.

The ranking process establishes priorities among the incremental levels of each decision unit (i.e., decision packages). The rankings therefore display a marginal analysis. If the manager of the Air Quality Program in Georgia developed decision packages for the Air Quality Laboratory, Reviews and Permits, Source Evaluation, Registration, and Research, his ranking might appear as follows:

Rank	Decision Package	Incremental Cost	Cumulative Program Cost
1	Reviews and Permits (1 of 2)	$ 116,000	$ 116,000
2	Source Evaluation (1 of 4)	103,000	219,000
3	Air Quality Laboratory (1 of 3)	140,000	359,000
4	Registration (1 of 3)	273,000	632,000
5	Source Evaluation (2 of 4)	53,000	685,000
6	Air Quality Laboratory (2 of 3)	61,000	746,000
7	Source Evaluation (3 of 4)	45,000	791,000
8	Air Quality Laboratory (3 of 3)	45,000	836,000
9	Reviews and Permits (2 of 2)	50,000	886,000
10	Research (1 of 2)	85,000	971,000

From a practical standpoint, the rankings of the minimum levels for Reviews and Permits, Source Evaluation, Air Quality Laboratory, and Registration may be requirements, so that the absolute ranking of those decision packages (ranked 1-4) are not meaningful. However, the priority of the packages with a lower ranking become significant since management will ultimately make a decision on which packages will be funded. If packages one through eight are funded, management would approve a budget for Air Quality Control of $246,000. Management would have funded all three levels of the Air Quality Laboratory, thus increasing that budget; funded only the minimum level of Registration, thus decreasing that budget; and not funded any Research, thus eliminating that function. Discretionary programs may have the minimum level ranked at the medium or low priority, while increased levels for other programs may be given a high priority. Therefore, the rankings can produce dramatic shifts in resource allocations.

The key to an effective review and ranking process lies in focusing top management's attention on key policy issues and discretionary expenditures. In a small organization such as the City of Garland, Texas, all decision packages were reviewed by the city manager. The city manager took the lower priority packages from each organization that he thought were somewhat discretionary and concentrated his ranking efforts on developing a consolidated ranking across all city organizations for those discretionary decision packages.

In large organizations, top management may be forced to rely primarily on management summaries in lieu of concentrating on the decision packages. In the State of Georgia, decision packages are ranked to the program level in each agency. The Budget Office prepares executive summaries based on the decision packages and program rankings submitted by each agency for the governor's review.

It is also possible to prepare "activity decision packages" (an activity being the lowest element in the program structure). Activity decision packages would then be ranked for each program. "Program decision packages" could then be prepared based on the activity decision packages and the ranking at the program level. The program decision packages could have a format and content similar to the activity decision package, but provide a summary and program analysis for use by top agency management and the executive and legislative review process.

Regardless of organizational size and form of top management review, the decision packages and rankings form the backbone of analysis and decision making. The nature of each review process must be specifically designed to fit the size and personality of each organization.

Preparing the Detailed Operating Budget

The budget or appropriation requests prepared by each organization are usually subject to some form of legislative review and modification. If the legislative appropriation differs markedly from the budget request, many organizations that have used traditional budgeting techniques are forced to recycle their entire budgeting effort to determine where the reductions should be made. Under the zero-base budgeting approach, the decision packages and rankings determine specifically the actions required to achieve any budget reductions. If the legislature defines reductions in specific program areas, we can readily identify the corresponding decision packages and reduce the appropriate program and organizational budgets. If the legislature identifies an arbitrary reduction (e.g., reduce budget five per cent), each agency can use its rankings and eliminate those decision packages that it considers to be the lowest priority.

In the final analysis, each organization will have a number of approved decision packages which define the budget of each program and organizational unit. The decision packages also define the specific activities and performance anticipated from each program and organizational unit. This information can provide the basis for both budget and operational reviews during the year.

Practices and Problems

The term "zero-base" has many different connotations. To those who have merely heard the term, it tends to mean "the process of throwing everything out and starting all over again from scratch," or "reinventing the wheel." These connotations are incorrect and imply an effort of impractical magnitude and chaos.

In a more practical vein, "zero-base" means the evaluation of all programs. The evaluation of alternatives and program performance may occasionally lead us to completely rethink and redirect a program, in which case we do "throw everything out and start all over again." However, in the great majority of cases, programs will continue, incorporating modifications and improvement. For the majority of programs, we will concentrate our analysis on evaluating program efficiency and effectiveness and the evaluation and prioritization of different levels of effort.

This pragmatic approach offers us an extremely flexible tool. Managers can "reinvent the wheel" in those situations where preliminary investigation indicates the need and potential benefits of such an approach, and can concentrate their effort on improving programs that appear to be headed in the right direction.

The zero-base approach has led to major reallocation of resources. For example:

- The State of Georgia experienced a $57 million (5 per cent of general funds) revenue shortfall. Governor Jimmy Carter used the zero-base analysis to reduce budgets across 65 agencies, with reductions ranging from 1 per cent to 15 per cent. Program reductions within each agency ranged from no change to elimination.

In a political environment, the expectations for major shifts in resource allocations must be qualified. The major reallocations of resources will normally take place within major agencies such as shifting administrative and maintenance cost savings into direct program delivery. However, it is unrealistic to expect a 20 per cent decrease in the Department of Education to fund a 40 per cent increase in Mental Health. The political realities do not usually allow such shifts. It is also unrealistic to expect an automatic tax reduction due to zero-

base budgeting. When cost reductions are achieved, the overriding political tendency is to plow the money back into increased services in other programs.

If we can't realistically expect major funding reallocations among major agencies, and if we can't expect a tax decrease, then why do zero-base budgeting? I believe that there are four overriding reasons that make the zero-base approach worthwhile:

1. Low priority programs can be eliminated or reduced. How the savings are used is a completely separate question.
2. Program effectiveness can be dramatically improved. Such improvements may or may not have a budgetary impact.
3. High impact programs can obtain increased funding by shifting resources within an agency, whereas the increased funding might not have been made available had the agency merely requested an increase in total funding.
4. Tax increases can be retarded. The first three benefits can significantly reduce the necessity for increased taxes by allowing agencies to do a more effective job with existing revenues. For the hard-nosed executive or legislature, budgets can be reduced with a minimum of reduced services.

The zero-base approach is not without its problems. The major problem is the threat that many bureaucrats feel towards a process which evaluates the effectiveness of their programs. The zero-base process also requires a great deal of effective administration, communications, and training of managers who will be involved in the analysis. Managers may also have problems in identifying appropriate decision units, developing adequate data to produce an effective analysis, determining the minimum level of effort, ranking dissimilar programs, and handling large volumes of packages. For many programs, workload and performance measures may be lacking or the cause/effect and program impact may not be well defined so that the analysis will be less than perfect. Therefore, zero-base budgeting should be looked upon as a longer-term management development process rather than a one year cure-all.

If done properly, the zero-base approach is not subject to the gamesmanship one might anticipate. The traditional budget approach offers maximum opportunity for gamesmanship because current operations are seldom evaluated and many discreet decisions are never explicitly identified and get "buried in the numbers." However, the zero-base approach removes the umbrella covering current operations and requires managers to clearly identify operating decisions. In zero-base, most obvious forms of gamesmanship would be to avoid identifying reasonable alternatives, to include the pet projects within the minimum level package, and to rank high priority programs low in the ranking in order to obtain additional funding. If the decision packages are "formatted" adequately to display the alternatives considered, workload and performance data, descriptions of actions, and enough cost data so that discretionary items cannot be built into the cost estimate, it becomes very obvious when such gamesmanship is attempted. Also, because the entire ranking of decision packages must be displayed, it is very easy to challenge a high priority item that received a low ranking or a low priority item which received a high ranking.

The problems in implementing zero-base budgeting are not to be minimized. The specific needs, problems, and capabilities of each organization must be considered in adapting the zero-base approach. Although most of the basic concepts of the zero-base approach have been maintained, the specifics of administration, formats, and procedures have been different for each organization that has adopted the approach. Zero-base can be applied on an intensive basis throughout all levels of an organization, applied only to selected programs, or applied only at major program levels rather than involving all operating managers. The strategy of implementing the zero-base approach must be developed for each organization, depending on its specific needs and capabilities. It should be considered a management and budgetary improvement effort that may require several years to reach full utilization and effectiveness.

Do the conclusions reached by Manners and Steger concerning 47 R&D managers of a large industrial company fit ARS managers? After making allowances for such private sector terms as "sales" and "company," I believe they do. I'd be interested in your reactions to this article.

-- Chet Cotton

Technical and Management Note

Behavioral Specifications of the R&D Management Role

GEORGE E. MANNERS, JR., AND JOSEPH A. STEGER

Abstract—In order to define behaviorally the R&D manager's job, extensive interviews and observations were conducted of R&D managers. The result is a categorical description of the R&D manager's job with a start on behavioral definition in each category. A validation of the categorical model was performed.

Since Fayol [1] first articulated what he believed to be the functions of a manager, little, if any, refinements have been offered by practitioners or scholars. This is not to say, however, that little has been written on the subject. The past few decades have offered a labyrinth of books and articles on leadership, motivation, etc., that have completely overlooked the fundamental question: What does a manager do? And more specifically what does an R&D manager do?

The purpose of this research was to investigate the behavioral requirements of R&D management as well as outline the results of such a study in a research laboratory of a major electronics manufacturer.

METHOD[1]

Data were collected from personnel source documents already available within the laboratory of a large industrial company (i.e., developmental plans, supervisory evaluations, etc.), the use of a critical incident survey on management of R&D, interviews with 47 R&D managers, and observational sets of R&D managers at work. Independent management ratings of managerial effectiveness were used as criteria.

After all the aforementioned data were analyzed, a categorical model was developed to capture those behaviors necessary to R&D management.

RESULTS

The model or categorical framework which evolved essentially encompasses three sets of constructs:[2]

1) Management functions (those behaviors which are characteristic of the functions studied and may vary in presence and/or intensity depending on the job):
   salesmanship;
   administration;
   technical professionalism;
   influence and control;
   training and development;
   forecasting and planning.

2) Management relational factors (those behaviors which are universally "prescribed" and are also essentially prescriptive in their focus):
   motivator;
   director;
   evaluator.

3) Target scope:
   subordinates;
   supervisors;
   peers;
   external;
   self.

The management functions may be defined by the following characteristics.

1) Salesmanship

The manager must serve as spokesman for his group. And, in this role he sells the group to upper management, his peers, and to people external to his organization. This activity also requires the manager to sell to his own people. He must sell his subordinates on various projects, ideas, etc.

The selling role can best be defined as a communication act. The manager communicates with the intent to convince some target of his position and/or credibility on some specific topic. He may sell an outsider on a product, he may sell his superiors on the capability of his group, or he may sell his subordinates on some idea they should incorporate in daily operations.

The other activity that is incorporated in this sales function is the keen eye for productive, useful, or profitable ideas, markets, products, techniques, or customers. As a sensor for such things that eventuate in a salable outcome, it is still within the sales function. Also within the search activity is the quest for talent. Thus, recruiting in the sense of selling the organization is included within the sales function.

In essence, this function can be summarized as one of convincing or evidencing a position and can be observed by the extent to which the target agrees, accepts, or acts in harmony with the managers' message intent.

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[1] For a detailed description of the methodology contact the authors.
[2] These sets are shown as independent for pedagogical purposes only—they are seen as interdependent.

2) Administration

This role refers to the many activities required of a manager by organizational rules and regulations. The filling out of forms, the scheduling of specific events, the specification of various topics by memo, the response to requests in the administrative sense, etc., are all examples of such activities. Also included in this function is the skill of decision making inherent in his daily operating role; that is, to *sort and react* to the information, requests, and demands coming across his desk continuously.

The research scientist is as uncomfortable as any other individual when confronted with organizational ambiguity. As such, the administrator keeps order in accordance with company policy in such specific content areas as attendance, maintenance, and certain financial concerns. In short, he maintains a smooth-running shop.

3) Technical Professionalism

This role can best be thought of as expertise or knowledge in some area of content. Although the manager may not be the most competent in the organization in some specific area of content, he must have a level of expertise that enables him to serve as a person who can provide critical questions and substantive direction. As such, he must be viewed as a true professional. By professional is meant a person who has both the formal credentials, such as education, and is perceived by his organization as one who could perform some job requiring much more than superficial knowledge or skills.

The preceding definition does not mean that as manager the person is in fact *acting* as a technical expert. In most situations this would not be desirable. But what technical competence would enable a manager to do is converse in the technical jargon, make judgments based on familiarity with new developments in the field, and also be able to suggest possible avenues of *payoff* that should be explored.

4) Influence and Control

If one has already read the description of the sales role of the manager, then there is some confusion as to influence and control since in large part the sales function has an influence component. However, we view influence and control as having as its major component the aim of a more direct influence attempt. There is little compromise suggested. Whereas in salesmanship the target can ignore the message, this is not true with the influence and control function. Also, the present function implies negative as well as positive sanctions.

Thus, the manager in this role directly attempts control. He states the goal and who is to accomplish that goal. The influence is exerted from a position of recognized authority within the organization and compliance is generally accepted.

Within this function the manager may demand a job be done, a rule adhered to, or a decision abided by.

5) Training and Development

The manpower development role has two facets to it. One might be labeled the formal organizational training and development program and the other the manager's own employee developmental efforts. The former is usually dictated by general company policy and is more structured and less variable in nature in that training courses are specified or layed out by criteria such as time on the job or management level. Thus, the employee may be sent to a short course on general management after, say, three years service or to a nearby university for advanced training in some technical area.

The "informal" training and development performed by the manager is usually tailored to each member of his work group. It is also highly experiencial and task specific in nature. Thus, the manager may take a certain scientist to meet a customer and make a presentation because he knows that the scientist needs practical experience in customer interaction and selling. Or he might have a particular individual prepare a budget for a project to help train him in the administrative aspects of the organization.

Training and development are, in short, a combination of organizational training and personal experience provided or shaped by the manager.

6) Forecasting and Planning

This role of the manager is best summarized as predicting and specifying the resources needed to do a job in the future a job that he, personally, may or may not have defined. Forecasting and planning are pervasive, although the scope and breadth of such activities vary with authority level.

In this function the manager must integrate information from various sources such as technological journals, government and company reports, popular literature, professional meetings, etc. From this he must project his group's path into the future. The matching of his resources, his group's potential and existing strengths, and the future's needs and opportunities define planning.

The manager is required, in detail, to specify goals, objectives, paths, and milestones–as well as associated costs. He must plan phase outs, start ups, and project manpower as well as material needs to accomplish these. Above all, the manager must define his group's worth in future activities. In short, he must prepare a blueprint for output, input, and allied activities such as recruiting, development, etc.

The target set includes the following factors.

1) Subordinates: This set includes anyone in the organization below the manager's organizational level. In general, these are the people directly under his authority, but it may at times include people beyond his formal authority. Thus, for example, he may be trying to sell a scientist from another division in the organization to join his group.

2) Supervisors: The major target in this set would generally be the manager that the person (also a manager) reports to. Also included in this set are, of course, other managers that hold a higher position.

3) Peers: This target set is obviously all those managers at the same organizational level as the manager under consideration.

4) External: The external target set is comprised of subsets. These include such targets as customers, community groups, professional groups, vendors, etc. The major defining characteristic is that these targets are outside the particular work organization of the manager being referenced.

5) Self: As a target set, we need only offer the observation that many managerial activities such as training and development, motivation, and evaluation (to name a few) are essentially intrapersonal.

The relational factors may be defined by the following aspects.

1) Motivator: This factor is best defined as arousal or energizing. The manager establishes a pace. He engenders enthusiasm. The target is moved to action. The target feels a necessity to become involved.

It should be noted that nothing about the direction of the target's activity is mentioned. The motivational aspect of the manager's role is to excite and arouse. It implies nothing about direction.

2) Director: As was mentioned previously, the director is the goal setter and definer of direction. He points the way. The direction or goal as set in this dimension can appear within any of the role dimensions. Thus, he can set a technical goal, a direction in planning, or an aim in training and development.

A comment is necessary to differentiate the director factor from the influence and control role. The director factor is one of selecting and defining end points or directions. The major component is manifested by saying, showing, or *demonstrating* where the organization is going.

The role behaviors are simply defined as activities that operationalize the director dimension. Thus, the use of the reward system to achieve a goal, or the ordering of a specific act is to play out a mangement role to accomplish an end that was set within the director dimension.

3) Evaluator: This is probably the most readily understandable of the three prescriptive sets. The manager as evaluator is defined as a combination of sensor and assessor. The manager scans the information or inputs and makes an appraisal. The appraisal is, again, operationalized within the role behaviors. Thus, for example, he evaluates the future within his technical profession to do his forecasting and planning.

Validation

Discriminate analysis was used to identify what variables optimally separated the four groups of managers that had been classified as 1) promotable two levels, 2) promotable one level, 3) doing satisfactory at current level, and 4) not satisfactory. The target set was collapsed and the management functions and relational factors were not assumed to interact. In other words, there are nine independent variables–the six management functions and three relational factors.

Two significant (p=0.10) discriminant plans (roots) separated the four management groups (for root 1, $X^2 = 28.34$, $d.f. = 11$, $p = 0.0035$; for root 2, $X^2 = 16.06$, $d.f. = 9$, $p = 0.0661$). The discriminant weights for each root are shown in Table I.

The only nonsignificant variables determining the separation of the four groups were salesmanship, administration, and director. For salesmanship, the reason for nonsignificance was that most every manager viewed it as very important! Thus, it did not discriminate. For administration, most managers also considered it important but

excessive. As for director, most felt it to be very unimportant—not because of any democratic ideals but because 1) strong direction was set up at the top and 2) as far as daily activities are concerned, a scientist possessing an earned doctorate was seen as needing little directing.

DISCUSSION AND CONCLUSIONS

While this was but a part of a program of research to specify those behaviors that define the R&D manager's job, it provided a beginning that has been shown to have concurrent validity.

Current work includes another set of variables, namely, style (the interpersonal interface) as well as those defined in this note. Hopefully, the behavioral specifications by category will lead to applications in selection, training, and evaluation of R&D managers.

A current working hypothesis is that the relational factors should provide the main focus for selection while the management functions are the pertinent set for training. Young adults with advanced education have either acquired the behaviors called for in the relational factors or they have not—and there is not much an organization can do to alter it. On the other hand, the behaviors called for in the management functions are, in large part, acquirable through experience, continuing education, etc. This is particularly true when concern for the target set is introduced.

Hopefully, the end product shall be to state the predictors of R&D management effectiveness in terms of observable behavior.

TABLE I
Discriminant Weights for the Two Roots Separating the Four Management Groups

	Root 1	Root 2
Salesmanship	.0230	.1906
Forecasting & Planning	.2883*	.0763*
Administration	.2746	.0336
Influence & Control	.0123	.4671*
Technical Professionalism	.2920*	.3117*
Training & Development	.1979	.4102*
Motivator	.7518*	-.6059*
Director	.2078	.2922
Evaluator	.3285*	.1433*

Note: Asterisk (*) indicates statistical significance.

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[1] H. Fayol, *General and Industrial Administration.* (London: Sir Isaac Pitman and Sons, Ltd., 1949).

ABSTRACTS

Barnowe, J. Thad. "Leadership and Performance Outcomes in Research Organizations: The Supervisor of Scientists as a Source of Assistance," Organizational Behavior and Human Performance, 14, (1975), 264-280.

Barnowe surveys the existing research concerning the relationship between research performance outcomes and leadership practices. He cites four questions which remain unanswered: (1) What is the impact of the leadership of research on the outcomes of that research? (2) What aspects of leader behavior have a positive effect on research outcomes? (3) Does the variable of "applied" versus "basic" research make a difference in the answers to the above two questions? And (4), what are the conditions which can affect the importance of leadership to research productivity?

His findings were somewhat less sweeping than the four questions above. He found that factors including type of supervision, and the activities of the supervisor, taken together, were able to explain 18% of the variance in research output. He also found that leadership assumed greater importance in stimulating producivity when the scientists supervised were in some way "disadvantaged," that is, where they were out of touch with peers in their fields, or where they were inexperienced. Barnowe concludes that the study found some answers to questions 1, 2, and 4 above, but much work remains to be done in this area.

Bylinsky, Gene. "Big Science Struggles With The Problems of Its Own Success," Fortune, 96, (July, 1977), 61-69.

Using the field of high energy particle physics as a sort of "worst case" example, Bylinsky looks at some of the trends abroad in the sciences, and their implications both for society and particularly for the scientist. He points out that the days of the independent, self-reliant scientist are, in a number of fields, completely over. The problems are so complex and the equipment required to study them so expensive and large, that "the scientist's work environment has come to have more in common with an assembly line in Detroit than with the quiet laboratory of popular imagination." When large teams of scientists are required to accomplish a given project, it is difficult for any but the leaders/senior authors to gain individual recognition and visibility via such projects. Team members even have difficulty discerning the exact part of a set of findings which represents their contribution.

Bylinsky also repeats concerns that the body of middle-aged, tenured professors in the system now will block the entry of new talent by virtue of seniority and experience. This forces young scientists to become followers of what is fashionable in their part of science. For both of these reasons, he believes that the current furor over both "red-shift astrophysics" and sociobiology can be traced to the conservatism inherent in fields dominated by senior scientists.

He concludes with a brief discussion of the pressures now on science: government pressure to be "practical," political pressure to be ideologically correct, and fear of DNA research.

Ginsburg, Lee R. "Career Planning: Steps You Can Take for Yourself," Supervisory Management, May, 1977, 2-10.

This article is in the form of a series of exercises the reader can do to plan his/her own career. One begins with inventories of educational accomplishments, occupational experiences, and special skills. Then, using checklists provided, the individual appraises his/her own personal needs, preferred organizational climate, most interesting activity types, and most important values. The advantages of arranging to take a battery of psychological tests are discussed, and the uses of performance reviews are covered. Ginsburg then describes places to find career information, and gives a step-by-step process to follow in making a career choice. Finally, he urges the reader to make up a career action plan, and suggests that it is advisable to discuss it with one's manager, if at all feasible. He concludes with the true, if trite, observation that all of the foregoing is pointless unless the individual takes responsibility for making it happen.

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